

Kansas DOT Cold In-Place Recycling

Federal Highway Administration National Review

Close out meeting, November 15-18, 2005

Purpose

The purpose of this review is to capture for technical deployment the most advanced uses of Cold-In-Place recycling (CIR) and then transfer the knowledge to all State Transportation Agencies (STA). Through this sharing of information, we intend to showcase how other STAs overcame barriers and advanced the routine use of CIR as a pavement rehabilitation strategy. “Best Practices” will be identified along with barriers and benefits. Specifications, construction practices, implementation challenges, and identification of ongoing and completed research will also be documented. This information will then be disseminated to all STAs through technical guidance, training, and guide specifications, as necessary.

General

- KDOT has used CIR successfully since 1977, for nearly 29 years, the pavement distress that they were addressing was early full depth cracking and low subgrade strength. The user was experiencing poor ride from transverse thermal cracking poor ride. Quality aggregate availability issues as well as asphalt stripping problems have significantly contributed to the use of CIR in Kansas.
- Use of CIR in Kansas has improved the pavement smoothness condition significantly to rank them in the top five in the nation for overall ride smoothness.
- Kansas has recognized the scarcity of quality aggregate and has effectively reused existing HMA pavement by using CIR. This has conserved their non-renewable resources, which has resulted in tremendous cost savings (\$____.00) to the state.
- Kansas has a well-documented Bid Tab system Pavement Management System (PMS) to track project details since October of 1992 to date. It indicates that over 6000 lane miles have been cold in-place recycled thus exhibiting a high degree of confidence in performance of the process.
- KDOT takes numerous 20- 40 core40 core samples per project ,project, DCP subgrade test of the cores holes are also done at this time, and gives them to SemMaterials, which in turn provides the project mix design, construction field adjustments, and provides technical guidance.
- For a CIR (4”) using approximately 3% engineered emulsion (PG 58-28), 1.5% Lime, and 1½”-2” overlay is what is provided in the bid documents. This process is expected to have a service life of 5-10 yrs with little standard maintenance.
- CIR is about 45% less cost then a 4” HMA overlay.

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- The CIR effort would have not been successful without the strong support from the KDOT upper management, strong partnership with emulsion supplier, and CIR construction industry.
- Contractors that specialize in CIR have a large capital equipment investment and recognize the importance of high quality workmanship.
- 1R CIR project mix designs are done by SemMaterials as comparison with Major Mods that are designed by KDOT in-house pavement design section using DarWin. A structural coefficient value of 0.25-0.28 is assigned to CIR layer.
- Under dry condition, KDOT requires 2% or less moisture content prior to HMA overlay; this usually happens within 48 hrs. Within 21 days prior to resurfacing, KDOT generally pays for patching of the CIR; after that time the contractor is responsible for such corrective action to the CIR before overlay.

Best Practices

- KDOT relationship between emulsion supplier, and CIR construction industry has fostered a very cooperative partnership to advance the CIR initiative. Annual meetings with all involved to review specifications and prior construction year issues has aided in improvements in the overall program. 20+ years of partnership
- KDOT primarily cold in-place recycle 4" of existing Hot Mix Asphalt (HMA) and overlay it with 1 1/2" to 2" of new wearing coarse using PG 64-28 to PG 76-28 to address the thermal cracking effects of the pavement.
- Using engineered emulsion with lime slurry is an improvement for overall performance; the lime slurry is providing early strength and anti-stripping, while the emulsion is providing a good bond for the material.
- Proper project selection with the use of dynamic cone penetrometer (DCP) has resulted in a better assurance that cold in-place equipment/process can be used.
- KDOT reviewed the experiences from New Mexico to utilize their best practices and adapt them to KDOTs geographical condition of shortage of good aggregate and poor subgrade.
- KDOT ride specification has resulted in an overall better quality workmanship.
- KDOT relies on test strips to establish density targets.

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- KDOT equipment specification requires that CIR equipment to be equipped with gradation screed, belt WIM scale, and secondary crusher to produce in-spec gradation materials and better control metering of lime and emulsion.
- Pre-construction meeting are held to ensure that all involved parties understand their responsibilities.
- SemMaterials, using KDOT core samples, provides a detailed project design to address mix stability, rutting, raveling, and crack resistance.

Barriers Overcome

- The performance of Fly Ash was found not to be acceptable and KDOT has learned that you should not recycle old CIR project, having Fly Ash, with CIR containing Fly Ash. KDOT has overcome this by using lime slurry and engineered emulsion. Use of Fly Ash has been discontinued November 2001.
- KDOT achieved proper project selection by the use of DCP to identify weak subgrade areas.
- KDOT corrected early issues with raveling by both engineered emulsion and lime slurry, and rutting by use of quick setting engineered emulsion.
- KDOT improved issues related to wet weather conditions by the use of fast setting emulsions. Older systems did not allow for early opening of the road.
- Older emulsion systems did not work as needed for CIR. The construction industry working with SemMaterials developed a better performing product.

Current Barriers/Issues

- KDOT last year had 12 CIR projects and is expected to reduce their number of CIR to 3 projects in 2006, which may have been partially due to Hot In-Place Recycling (HIR) alternative available at 2" depth.
- KDOT is looking at future research on using 2" CIR vs. traditional 4" for cost and performance effectiveness and comparison to HIR.
- KDOT ride specification has resulted in better quality workmanship. Better ride may be achieved by use of wedge and/or leveling coarse, a finer mix i.e. two 1" lift of 9.5 mm vs. one 2" lift of 12.5 mm mix.

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- Potential use of RAP, similar to adding stone, as a mean to increase pavement thickness to allow the use of CIR to potentially add structural capacity.
- CIR on pavements containing crack retardant materials such as Pertomat which hampers production

Follow up

- The need for better education and support to target pavement designers/consultants, and decision makers.
- Nationwide synthesis of past research.
- The need for designs to look at use of add-stone.
- Reports on long-term performance.
- Results of CIR uses on higher volume roads.
- CIR should be marketed as a pavement rehabilitation or pavement preservation tool depending on the magnitude of the project.
- Better documentation on performance of Chip seal and similar thin surface treatments over CIR.
- State DOT partnership with industry and contractors in working together to address curing time and moisture content specification, overlay criteria, and alternate solutions such as fog seal, etc.
- The use of mineral fillers and their effects on performance.
- The capital-intensive investment for contractors, and maintenance of skilled labor pool specific to this industry, requires having a sufficient volume of work. This is difficult due to current funding constraints, and competing program needs.
- Approved AASHTO specifications for CIR.